

Inorganic Chemistry

Fall 2012

M, W, F 9:30–10:20 a.m.; M 1:30 lab

201 Ebaugh; lab in 214 Ebaugh

Chemistry 417

Prof. Jordan Fantini

208 Ebaugh

x6491

fantinij@denison.edu

Laboratory meets Mon. 1:30–4:30 p.m. in 214 Ebaugh

Text: *Inorganic Chemistry*, 4th ed. Miessler & Tarr

Welcome to Inorganic Chemistry! I'm very glad that you're here. You may be wondering exactly what Inorganic Chemistry is, and there are surely a lot of ways to answer that question. On the simple side, we can say that inorganic is not organic chemistry, that is, it's concerned with all the elements that aren't carbon. But you won't be in inorganic chemistry very long before you notice that we deal with carbon too, just not in the way that organic chemists do. So, if it's not organic, and uses all the elements, that's a pretty broad field. Maybe inorganic chemistry should be described as a mindset. Professor Harry Gray of CalTech has called inorganic chemists "the marines of chemistry" for their willingness to tread fearlessly over all areas of the periodic table and apply diverse ideas of structure, bonding, and reactivity as warranted in different situations.

Inorganic chemistry is a broad field and, like organic chemistry, could easily fill two semesters and have plenty left over to learn. Since we have but one semester to explore the sub-discipline, we'll be selective, by necessity, about our coverage. Even in the areas we do cover, we'll treat them in different amounts of depth.

One can also bring different degrees of mathematical and chemical sophistication to the subject. We'll not assume a math background beyond first year calculus (we actually use little if any calculus) and not require any P-chem background at all. If you've been through second semester P-chem symmetry and group theory will be more familiar to you. Though we may go light on the math in places, we still seek sophistication in our models that help us to rationalize and understand chemical phenomena.

What kinds of goals do we have for the semester?

Our **content goals** span seven conceptual area, or **units**, each of which is a chapter or more in our textbook. The units, which have different lengths, are listed below, and are color-coded in the day-by-day guide to readings and assignments.

1. Intro/Atomic Structure/Simple Bonding Theory (Chapters 1–3)
2. Symmetry & Group Theory (Chapter 4)
3. Molecular Orbitals (Chapter 5)
4. Acid–Base & Donor–Acceptor Chemistry (Chapter 6)
5. The Crystalline Solid State, including X-ray crystallography (Chapter 7)
6. Coordination Chemistry (Chapters 9–10)
7. TM reactions (Chapter 12)

Our **broader impact goals** include:

1. learning and producing in the laboratory
2. laboratory report writing
3. making scientific oral presentations
4. working collaboratively (on problem sets and presentations)

How do we learn? (or) How should we spend 150 minutes a week together in class?

Let's just say that if we're spending 150 minutes a week together, I'm assuming you're spending 450 minutes a week (or more) on the course without me (leaving lab out of the calculations).

What are out-of-class things to do?

- book reading** There's a day-by-day schedule of readings. The book was chosen especially for this course, and I will tie my class lectures to the book as much as it is practical.
- suggested problems** Working problems is how we learn chemistry. Especially for the early chapters, nearly all of the problems are appropriate. Working on the problems is a major way to learn and gain familiarity with the material. I'll suggest problems to work on, and provide solutions. These problems won't be collected or graded.
- problem sets** There will be one set per unit that is written by me and has a mix of longer and shorter problems. These problems are for collaborative work and are graded and returned with feedback. Small groups of students are expected to work together constructively on these sets. (See assigned groups on page 6.)
- compose questions** Working on readings, homework problems, and problem sets is a great way to come up with questions about things you need a better understanding of. These questions provide the entry to a classroom experience that best matches your needs.

What should we be doing in class?

- raise questions...** ...and I'll develop answers that suit you and benefit the whole class.
- actively follow worked examples** I'll bring example problems and show approaches to solving them. Realize that developing skills to approach problems is as important as arriving at any specific answer.
- conventional lecture** To complement or enhance the textual coverage.

Grading (tentative weights shown):		Grade determination (tentative ranges):	
Two exams	30%	A:	90–100%
Final	15%	B:	80–89%
Quizzes/Problem Sets	15%	C:	65–79%
Presentation	10%	D:	55–64%
Laboratory	25%	F:	<55%
Class participation	5%		
TOTAL	100%		

The grade cut-offs will not be raised under any circumstances. The addition of “+” and “-” to grades near the cut-offs will be made in some circumstances at the instructor’s discretion.

I would like to hold scheduled office hours, but I have taken a look at your schedules and there is never a time where a majority of you would not be in a class or a lab. Therefore, to give the opportunity for everyone to come to office hours, the office hours will be by appointment. Please confirm any and all appointments by email or schedule at the following web address:

tungle.me/JordanFantini

Readings shown in the day-by-day calendar are from *Inorganic Chemistry*, 4th ed. Miessler & Tarr.

Required Materials:

- *Inorganic Chemistry*, 4th ed. Miessler & Tarr
- Lab Notebook of your choice, except not General Chem Style. Must have permanently attached pages.
- Access to a General Chemistry Text for treatment of the basics of structure and bonding.

Due dates and late work. Any assignments due on a day that class meets are due at the beginning of the class period. Late materials will be marked down 10% of the full point value of the assignment for each day late. This penalty will not be imposed on assignments turned in late on the same day they were due, or when the late submission is considered connected to an illness or similar circumstance. Assignments turned in late, especially after I have graded those of other students, may receive less feedback and be graded slightly differently (not intentionally harder, just different).

Exams. Exams will be take-home in nature. The final exam *will not* be a take-home exam. It is inevitable that exams will come around the time that you have other important commitments, for this course and others. Realizing this, please plan ahead in the management of your time to prepare for these exams to your own personal satisfaction. Exam 1 covers Chapters 2, 3, and 4. Given out September 28th; due October 3rd. Exam 2 covers Chapters 5, 6, and 7. Given out November 2nd, due November 7th. The Final (December 15th) covers Chapters 9, 10 and 12. All of the exams focus on the chapters listed, but may have a small connection to past material that fits in the context of the current material. A good example is that Unit 6 draws somewhat on Unit 3.

Quizzes. Quizzes are to help you keep up with the material. They are one or two questions, limited to under 10 minutes and drawn from the previous 1–2 days of course materials only. Your lowest quiz score will be dropped from grade calculation. Unexcused absence from a quiz results in a grade of zero for that quiz. Excused absences will result in a substitute score that is the average of all your other quiz grades.

Laboratory. In preparation for any laboratory, I expect you to have gathered all supplemental information possible and read it before coming to the laboratory. You will need to prepare your notebook with a reagents and materials table along with an outline of planned procedure before lab starts. Our experiments may come from the primary literature (e.g. *Journal of Chemical Education*). You will need to have access to a text that gives good detailed background on techniques to be used in the laboratory. Become familiar with this material before you come to lab in order to successfully perform the experiment.

Some experiments will require you to work briefly in the lab outside of the regularly scheduled period, at a time that is mutually convenient. Checking the status of a reaction reflux, checking a reaction to assure it hasn't dried up, or obtaining an overnight NMR spectrum are typical examples.

Laboratory Reports. Reports in the style of journal articles will be required for some experiments but most will have a shorter report format. High quality and detail is expected from beginning to end. We will not be doing report rewrites so be sure to put your best foot forward when you hand in a report.

Laboratory notebook pages will be collected and graded for each experiment. *I cannot stress enough the importance of keeping a good notebook.* Remember—notebook pages, when properly kept, can be used as legal documents. And, more importantly, they are the final, most important proof of your chemical work.

Presentations. The details of the presentation guidelines will be given in a supplemental handout.

Participation. In such a small class, participation can—and should be—enjoyable and exciting. The last few times I taught this course, I tried different ways to foster active class participation. This year, one way I hope to have set things up well from the start is in the choice of textbook. The text by Miessler & Tarr is one in which the authors aren't seeking to keep secrets from you. As I mentioned above, a lot of inorganic chemistry is unfamiliar, and I think these authors minimize the negative effect of the unfamiliarity by having an up-front approach to topics. Because of this, I consider this one of the most readable inorganic books I know. (Another good one is Housecroft & Sharpe; Cotton, Wilkinson and Gaus may be the most readable but is too shallow in depth to be used as a junior/senior level text.) So, since the book is readable, please do read it! Ahead of time. Come to class able to participate, able to answer reasonable questions I would pose, and able to ask reasonable questions of your own.

Use the class schedule above as a guide to the reading but realize that we could stray from those exact sections from time to time so be ready to read more or less from day to day. The assignments represent my best guess at what we'll cover and it's my expectation we'll keep on this schedule.

Homework. I will assign homework and problem sets. You should work on it—working through problems is how we learn material. The Problem Sets count as part of your grade. I will make solutions available to the book homework so that you may check your work on all the problems. In addition, you are encouraged to discuss the homework assignments with me and with your classmates both in and out of class (as class time allows). The problem sets you should work on in your assigned groups and turn in an single answer from the group. These will be returned graded with feedback and solutions

Academic Integrity Statement. Proposed and developed by Denison students, passed unanimously by DCGA and Denison's faculty, the Code of Academic Integrity requires that instructors notify the Associate Provost of cases of academic dishonesty, and it requires that cases be heard by the Academic Integrity Board. Further, the code makes students responsible for promoting a culture of integrity on campus and acting in instances in which integrity is violated.

Academic honesty, the cornerstone of teaching and learning, lays the foundation for lifelong integrity. Academic dishonesty is intellectual theft. It includes, but is not limited to, providing or receiving assistance in a manner not authorized by the instructor in the creation of work to be submitted for evaluation. This standard applies to all work ranging from daily homework assignments to major exams. Students must clearly cite any sources consulted—not only for quoted phrases but also for ideas and information that are not common knowledge. Neither ignorance nor carelessness is an acceptable defense in cases of plagiarism. It is the student's responsibility to follow the appropriate format for citations. Students should ask their instructors for assistance in determining what sorts of materials and assistance are appropriate for assignments and for guidance in citing such materials clearly.

As is indicated in Denison's Student Handbook, available through <http://mydenison.edu>, instructors must refer every act of academic dishonesty to the Associate Provost, and violations may result in failure in the course, suspension, or expulsion. (For further information, see <http://www.denison.edu/about/ducai.pdf>)

Integrity is a critical part of the scientific process; if your word cannot be believed, your academic reputation is destroyed for life. Please don't cheat—it is simply not worth it.

Harassment. Denison University "is committed to maintaining hospitable educational, residential, and working environments that permit students and employees to pursue their goals without substantial interference from harassment...regardless of race, sex, color, ethnic or national origin, religion, age, sexual orientation, disability, or Vietnam era veteran status." A more detailed description of University policy can be found in the student handbook concerning Antiharassment and Free Speech.

Disability Statement. Any student who feels he or she may need an accommodation based on the impact of a disability should contact me privately as soon as possible to discuss his or her specific needs. I rely on the Academic Support & Enrichment Center in 102 Doane to verify the need for reasonable accommodations based on documentation on file in that office.

Writing Center. The Center is a free resource available to all Denison students. Student writing consultants from many majors help writers one-on-one in all phases of the writing process, from deciphering the assignment, to discussing ideas, to developing an argument, to finalizing a draft. Check the website at <http://www.denison.edu/writingctr/> for more information.

Suggested reference texts:

Shriver, Atkins

(helpful for symmetry, generally a high level of detail)

Bowser

(fairly descriptive, generally a moderate level of detail)

Cotton, Wilkinson & Gaus

(helpful for bonding & descriptive, generally a low level of detail)

Wulfsburg

(a different approach than most inorganic texts. replete with depth and detail)

Laboratory Safety:

Safety Check List

Working in an organic chemistry laboratory poses certain risks, which we have attempted to minimize. However, safety in the laboratory requires a strong commitment from all of us.

1. Safety goggles must be worn at all times. Do not wear contact lenses in the lab if possible.
2. Do not bring food or other nonessential lab equipment into lab.
3. Wear shoes that cover the top of your feet. Sandals must not be worn in the lab at any time and shorts are discouraged. Clothing is much easier to replace than skin! Still, don't wear expensive clothing or nylons. A laboratory coat may be a good investment. Wear long pants or skirts over knees. Avoid loose clothing, i.e. baggy shirtsleeves, jewelry, ties etc. Tie back long hair.
4. Never work alone in the laboratory. Someone must always be aware of what you are doing. Unauthorized experiments are not permitted.
5. Know the location and purpose of the safety devices in your lab.
 - a. fire extinguishers
 - b. safety shower
 - c. eye wash/rinse hose
 - d. fire blanket
 - e. first aid kit
 - f. liquid spill kit
 - g. glass cleanup kit
 - h. fume hood fan switch and operation status
 - i. protective clothing (gloves, face shields, etc.)
6. Dispose of glassware and chemical wastes in the containers provided. Minimize the amounts of chemicals you use. Consult instructor for appropriate waste handling procedures.
7. Know the properties of the chemicals you are using.
8. Avoid the use of open flames.
9. Avoid contact with the materials you are handling. Inhalation and absorption through the skin or open cuts are common routes of entry. Gloves may be recommended for certain operations.

Laboratory Hygiene

It is important to leave the lab clean for the next group of students. Spills that you make around the balances and side shelves should be cleaned up immediately. Appropriately dispose of used pipets, weighing boats, etc. **Before you leave the laboratory**, gather up your equipment, sponge off your work area, and **put everything away**. Two students will be assigned each week to ensure the shared areas in the laboratory are clean.

Readings are FOR the day they are listed; stop at the point on the last page where a section (or sub-section) comes to an end.

lab	Monday	Tues.	Wednesday	Thurs.	Friday
Lab 1: cobalt 1 of 4	Aug 27 Ch 1 p.1–15	Aug 28	Aug 29 Ch 2 p. 16–37	Aug 30	Aug 27 Ch 2 p. 37–43
Lab 1: cobalt 2 of 4	Sept 3 Ch 2 p. 43–47	Sept 4	Sept 5 Ch 3 p. 51–57	Sept 6	Sept 7 Ch 3 p. 57–78
Lab 1: cobalt 3 of 4	Sept 10 Ch 3 extra time	Sept 11	Sept 12 Ch 4 p. 81–97	Sept 13	Sept 14 Ch 4 p. 97–108
Lab 1: cobalt 4 of 4	Sept 17 Ch 4 p. 108–120	Sept 18	Sept 19 Ch 4 extra time	Sept 20	Sept 21 Ch 4 extra time
Lab 2: zeolite 1 of 3	Sept 24 Ch 5 p. 126–133	Sept 25	Sept 26 lab 1 due Ch 5 p. 133–143 <i>EXAM 1 handed out</i>	Sept 27	Sept 28 Ch 5 p. 143–152
Lab 2: zeolite 2 of 3	Oct 1 Ch 5 p. 152–162 <i>EXAM 1 DUE TODAY</i>	Oct 2	Oct 3 Ch 5 p. 162–171	Oct 4	Oct 5 Ch 5 extra time
Lab 2: zeolite 3 of 3	Oct 8 Ch 6 p. 175–191	Oct 9	Oct 10 Ch 6 p. 191–204	Oct 11	Oct 12 Ch 6 p. 204–216
	Oct 15	Oct 16	Oct 17 Ch 7 p. 220–233	Oct 18	Oct 19 Ch 7 p. 233–243
Lab 3: polythiophene 1 of 3	Oct 22 Ch 7 p. 243–252	Oct 23	Oct 24 lab 2 due solids—X-ray	Oct 25	Oct 26 solids—X-ray
Lab 3: polythiophene 2 of 3	Oct 29 solids—X-ray	Oct 30	Oct 31 solids—extra time <i>EXAM 2 handed out</i>	Nov 1	Nov 2 Ch 9 p. 321–346
Lab field trip: TRIP for X-ray crystallography	Nov 5 Ch 9 p. 346–359	Nov 6	Nov 7 Ch 9 extra time <i>EXAM 2 DUE TODAY</i>	Nov 8	Nov 9 Ch 9 extra time
Lab 3: polythiophene 3 of 3	Nov 12 Presentations	Nov 13	Nov 14 Presentations	Nov 15	Nov 16 Ch 9 extra time
	Nov 19	Nov 20	Nov 21	Nov 22	Nov 23
Lab 4: thermochromic materials	Nov 26 Ch 10 p. 362–370	Nov 27	Nov 28 lab 3 due Ch 10 p. 370–389	Nov 29	Nov 30 Ch 10 p. 389–404
course evaluation/ check out	Dec 3 lab 4 due Ch 12 p. 442–458	Dec 4	Dec 5 Ch 12 p. 458–469	Dec 6	Dec 7 Ch 12 p. 469–479
no lab this day	Dec 10 Ch 12 extra time	Dec 11	Dec 12	Dec 13	Dec 14 Final Exam tomorrow --->